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Article *in* International journal of preventive medicine · March 2016

DOI: 10.4103/2008-7802.177862

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Psychometric Properties of the Iranian Version of the Diabetes Numeracy Test-15

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How to cite this article: Moradi Y, Baradaran HR, Khamseh ME. Psychometric properties of the Iranian version of the diabetes numeracy Test-15. Int J Prev Med 2016;7:43.

ABSTRACT

Background: Low health literacy (HL) of patients has obtained more attention as a risk factor for poor adherence to treatment and adverse outcomes in chronic disease's management particular in diabetes care. Diabetes Numeracy Test-15 (DNT-15) has been developed specifically for this purpose. The objective of the current study is to evaluate psychometric properties of Iranian (Persian) version of the DNT-15.

Methods: The shortened version of the DNT (15-items) was completed by 120 patients with diabetes. The Kuder–Richardson Formula 20 for internal consistency was conducted. Content validity, criterion-related validity, and construct validity were also evaluated.

Results: The average score on the DNT was 72% and took an average of 25 minutes to complete. The DNT-15 had a very good internal reliability (KR-20 = 0.90) and also content validity (content validity ratio: 089 and content validity index: 0.86).

Conclusions: The DNT-15 (Persian version) is a reliable and valid measure of diabetes-related numeracy skills for Iranian patients with diabetes; however, additional studies are needed to further explore the association between diabetes-specific numeracy and acculturation and their impact on diabetes-related outcomes in Iranian population.

Keywords: Diabetes, health literacy, Iran, validity and reliability

INTRODUCTION

The World Health Organization has defined health literacy (HL) as "the cognitive and social abilities which determine the incentive and ability of individuals to increase access to understand and use information in ways, which promote and preserve good health."[1] The HL of patients has obtained more attention as a risk factor for poor adherence to treatment and adverse outcomes in chronic disease's management particular in diabetes care.[2-5] Diabetes is the most common metabolic disease with a dramatic increase rate of prevalence throughout the world,[6] which has an important impact on the public health and quality of life of the patients.[7]

There is a developing frame of the literature that discovers the association between HL and health outcomes in people with diabetes. Older studies of low HL reported adverse effects on diabetes-related health outcomes;[8,9] however, more recent studies showed no association between HL levels and intensity, frequency or incidence of outcomes, and thus the effect of HL on the health of people with diabetes is yet unclear.[10,11] Based

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DOI: 10.4103/2008-7802.177862

on national reports, the prevalence of diabetes has been raised during three decades in Iran and also a recent national survey about HL has shown that majority of people has inadequate knowledge.[12] However, there are different tools to measure HL and numeracy skills in general population in different languages, only Diabetes Numeracy Test-15 (DNT-15) has been developed specifically to measure numeracy skills in patients with diabetes as first scale by Huizinga *et al*., in English language.[5] With regard to lacking of appropriate measurement tool for patients with diabetes in Persian (Farsi) language, this study aimed to provide evidence for the psychometric properties of the Iranian (Persian language) version of DNT-15.

METHODS

The questionnaire

The DNT was designed to evaluate nutrition, exercise, glucose monitoring, oral medication, and insulin skills that patients may encounter during daily diabetes self-management. There are three nutrition items fixing on nutrition label interpretation and carbohydrate counting. One exercise items evaluate carbohydrate intake and insulin adjustment for exercise time. Blood-glucose monitoring skills are evaluated by three items about number hierarchy, glaciated hemoglobin, and calculating supplies needed. Eight items assess the oral medication use and insulin use. Oral medication (one question) use refill patterns and dates, and oral titration schemes and insulin use (seven questions) including interpretation of syringes, correction or sliding-scale insulin use, insulin adjustment for carbohydrate intake, and titration instructions [Table 1]. Items are scored as binary outcomes – correct or incorrect – and no partial credit is given. There is no time limit for the administration of the scale. Many patients with diabetes use calculators; therefore, participants were allowed to use calculators during the administration of the DNT to emulate real-life circumstances. DNT scores are reported as percent correct (with a possible range of 0% to be 100%).[5]

First phase: Forward translation

In this phase, the original questionnaire was translated by two independent health professionals from English to Persian. After translation, by consultation with the principal investigators, the results were rechecked. Finally, they achieved a precision translation for the questionnaire.

Second phase: Backward translation

In this phase, the questionnaire that translated in the previous step, gave to two professional translators whose native language were English, and they are sufficient dominance in Persian language. The translators did not communicate with one another and did not know the original English version. Translated versions by consultation with the principal investigators of conversion backward translation were combined.

Table 1: Description of diabetes numeracy test items

	Question number
Domain	
Nutrition	1-3
Exercise	4
Blood glucose monitoring	5-7
Oral medication use	8
Insulin use	9-15
Math problem type	
Addition/subtraction	8,15
Multiplication/division	1,6,10
Fractions/decimals	2,3
Multi-step mathematics	4, 12-15
Time	7
Numeration/counting/hierarchy	5, 9, 11

Third phase: Expert groups

In this phase, a group of experts was reviewed, all phases, including verification and cross-cultural equivalent (cross-cultural equivalence). Cultural equivalent to the word (semantic), a term equivalent (idiomatic), and equivalent experience (experiential), and conceptually equivalent (conceptual) were performed by an expert panel. This group included experts in diabetes, certified diabetes educators, methodologist, primary care providers, and registered dietitians, behavioral researchers in diabetes, and literacy and numeracy experts. Finally, the DNT was to address the clarity of items for patients with diabetes. Ten cognitive response interviews were conducted with patients with diabetes to evaluate each item. Interviewees were asked specific questions about each item to evaluate the understandability of the wording. If an item was unclear, the interviewee was told the purpose of the item and then encouraged to suggest a different format or wording. In response to the interviews, the scale was reformatted and slightly reduced to the final 15-items. Reliability was evaluated by internal consistency (Kuder-Richardson 20), and validity was evaluated through content validity ratio (CVR) and content validity index (CVI).

Participant selection

A convenience sample of 120 patients with diabetes was interviewed in the diabetes clinic affiliated to Institute of Endocrinology and Metabolismof an item at clinic visits. Any person diagnosed with Type 1 and or Type 2 diabetes which was able to read (at least eight grades)

and speak Persian language. Potential participants were excluded if they corrected visual acuity was >20/50 using a Rosenbaum Pocket Vision Screener, or if they had a diagnosis of significant dementia, psychosis, or blindness.

RESULTS

The characteristics of participants demonstrated in Table 2. The mean age was 51.2 years, and 64% of the participants were male. The 15-item DNT took an average of 25 min to complete. The average score (±standard deviation) on the DNT was 72% ±22. Difficult issues for participants included titration schemas, food label interpretation, insulin adjustment instructions, and items that required multi-step math (e.g., calculating insulin dosage based on carbohydrate intake and glucose level). Two commonly used methods for sliding-scale insulin adjustment instructions are displayed. Questions 2, 5, 6, 7, 8, 9, and 11 were answered accurately respectively by 89.1%, 78.2%, 87.4%, 72.3%, 85.7%, 84%, and 83% of participants for this study. However, questions 14 and 15, which required patients to interpret a word problem and apply multiple numerical steps to determine their insulin dosage, was only answered correctly, respectively by 41%, 54% of the participants. The 15-item Persian version of the DNT has highly reliable, as determined by internal consistency Kuder–Richardson (KR-20 = 0.90). Content validity was examined by the expert panel (CVR: 089 and CVI: 0.86).

DISCUSSION

The short version of the DNT-15 demonstrated internal consistency and construct validity in relation to reading skills in Persian (Farsi) language in Iranian population. Scores on the DNT-15 showed a direct correlation with level of education in this study which is consistent with other reports.[5,10] Although there have been some reports about HL in Iran they were not specific about diabetes in Iran.[12,13]

Other studies have identified the role of HL techniques in the improvement of health outcomes in diabetes and congestive heart failure.[5,15,16] Patients with low HL may benefit from interventions that address numeracy, particularly in the setting of diabetes management. The DNT-15 can provide a measurement of diabetes-specific numeracy and provide more information on the role of disease-specific numeracy in future studies. More studies are needed to further understand the role of numeracy tailored interventions for the management of diabetes.[3,4,14,17-19]

There are also clinical implications that can be learned from this study. We learned that the framing of instructions was very important in predicting patient performance. For example, study participants had a difficult time with the multi-step math required to calculate a correction dosage of insulin when instructions were presented as a sequence of sentences. This is with line with other studies.[20,21] This item was encompassed to mirror clinical practice regarding how patients are currently instructed to take their insulin. This example provides an important lesson for health care providers and educators in effective communication styles for all clinical care recommendations.[22]

Table 2: Patient characteristics (*n*=120)

Characteristic	Mean±SD or n (%)
Age	51.211
Gender	
Male	64 (53.3)
Female	56 (46.4)
Education	
Diploma	24 (20.0)
High diploma	20 (16.7)
Bachelor	49 (40.8)
Masters	22 (18.3)
PhD	5 (4.2)
Duration of diabetes	
5 year	35 (29.5)
5-10 year	32 (26.7)
10-15 year	30.0)
>15 year	17 (14.2)
Drug use	
Insulin	86 (71.7)
Tablet	34 (28.3)

CONCLUSIONS

The Persion (Farsi) version of DNT-15 is a reliable and valid tool to measure of diabetes-specific numeracy skills for patients with diabetes.

Received: 24 Feb 15 **Accepted:** 26 Sep 15
Published: 01 Mar 16

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Source of Support: Iran University of Medical Sciences, **Conflict of Interest:** None declared.